SAND2014-2314C

*Exceptional service in the national interest*

Sandia National Laboratories

# U.S. Public Perspectives on Nuclear Issues between 2011 and 2013

Public Engagement Commission on Spent Nuclear Fuel Management
Seoul, ROK
18 April 2014

Dr. Evaristo J. (Tito) Bonano*, Co-Director
Dr. Hank Jenkins-Smith*, Co-Director
Dr. Carol Silva**
Center for Energy, Security & Society

*Sandia National Laboratories
Albuquerque, NM USA
** University of Oklahoma
Norman, OK USA

U.S. DEPARTMENT OF ENERGY | NNSA

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND NO. 2013-XXXXP

# University of Oklahoma and Sandia National Laboratories have created study center

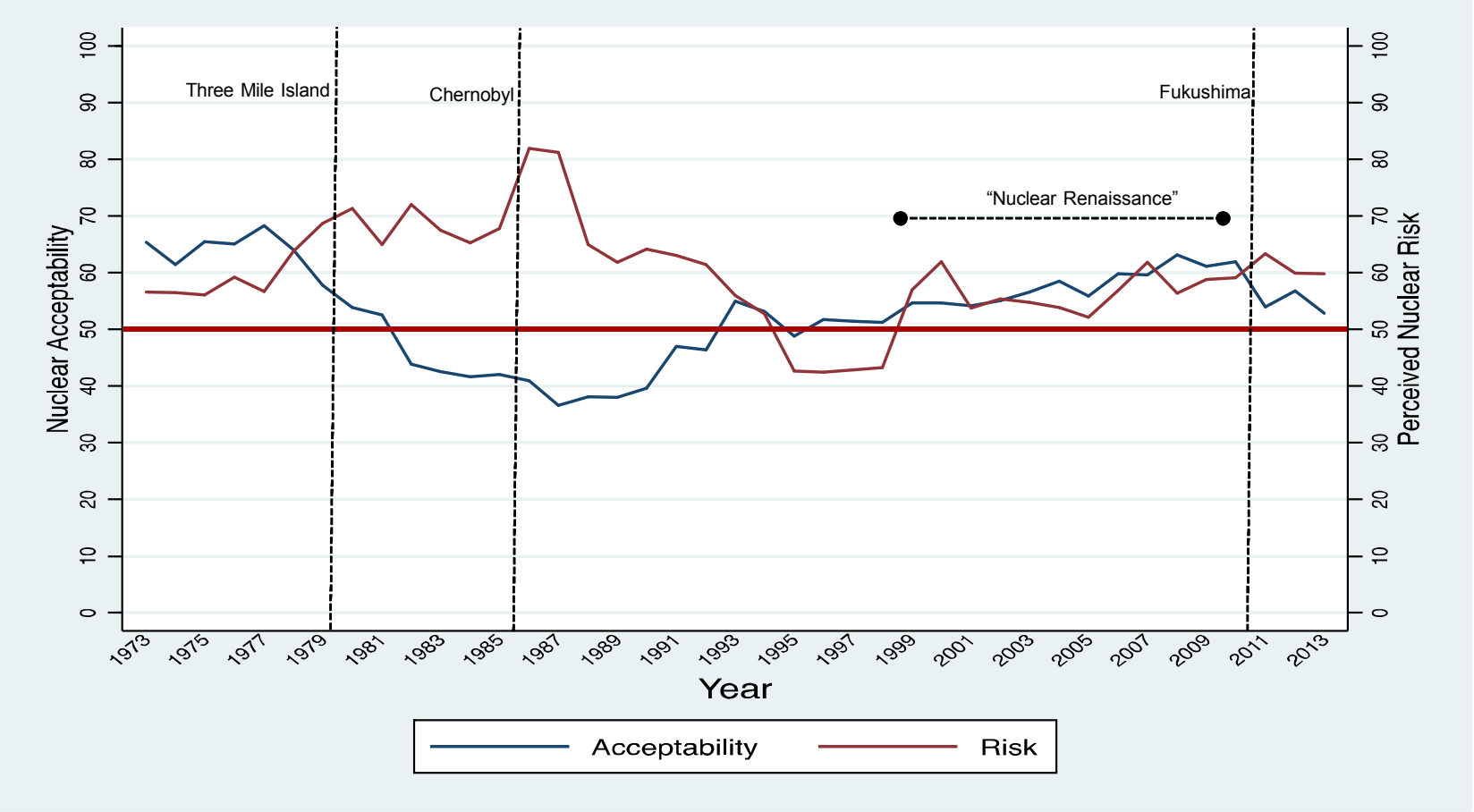
- In 2006, University of Oklahoma started and has maintained a unique program for collection of national surveys of public perceptions on nuclear fuel cycle
- Sandia, through DOE and NRC, has been involved since early 1970s on technical issues related to the nuclear fuel cycle
  - Reactor safety
  - Transportation and storage
  - Lead laboratory on performance assessments for disposal of nuclear waste (Waste Isolation Pilot Plant in New Mexico and proposed Yucca Mountain repository in Nevada)
- Created joint center to study energy and security issues related to society

# US public perspectives on nuclear issues between 2011 and 2013

Sandia National Laboratories

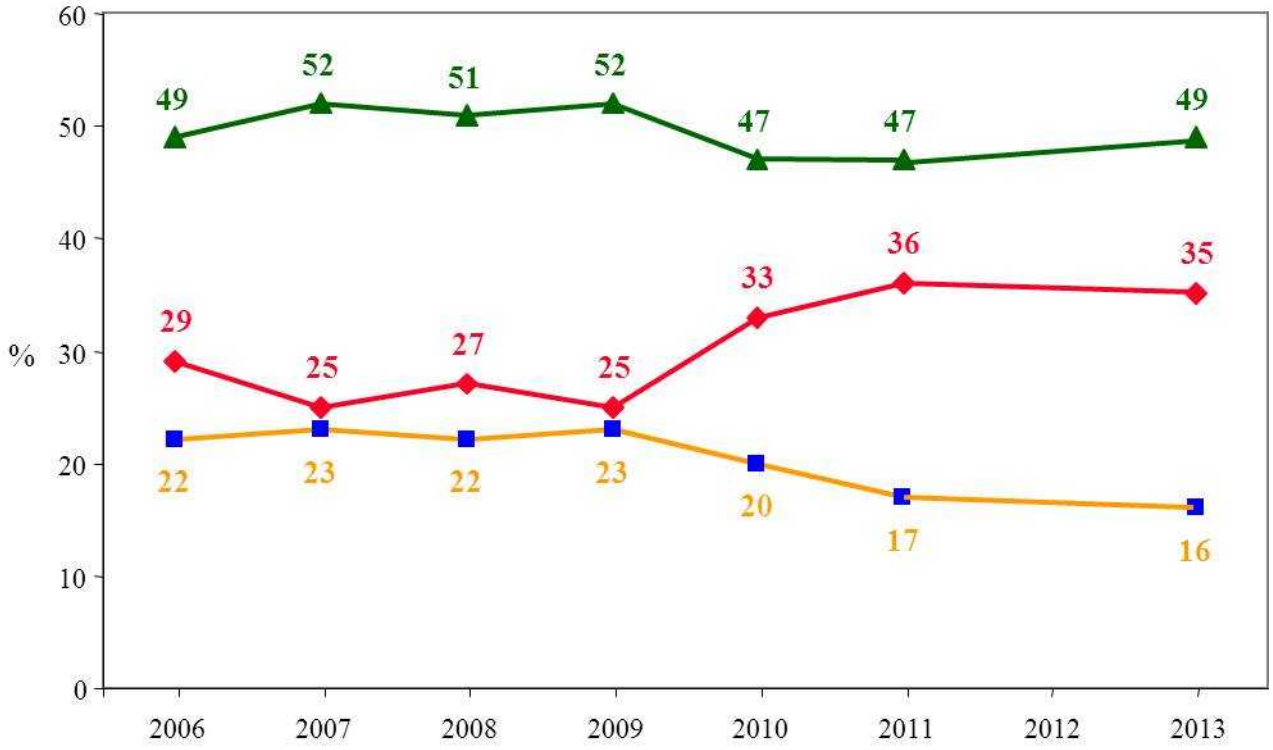
- Nuclear energy in US context
  - Trend in support for nuclear energy
  - Implication of beliefs on climate change
- US National public awareness of SNF cycle
- Geologic disposal and interim storage
  - How options are presented matters
  - Implications of proximity
- Desirable characteristics of storage and disposal
- Institutional considerations and public engagement

# Trend in attitudes about risk and acceptability of nuclear energy in US between 1973 and 2013



# Trend in preferred energy sources in US

- Nuclear energy still seen as important energy source in next 20 years, as measured since 2006




2006–2013

Renewables: 0 .0%

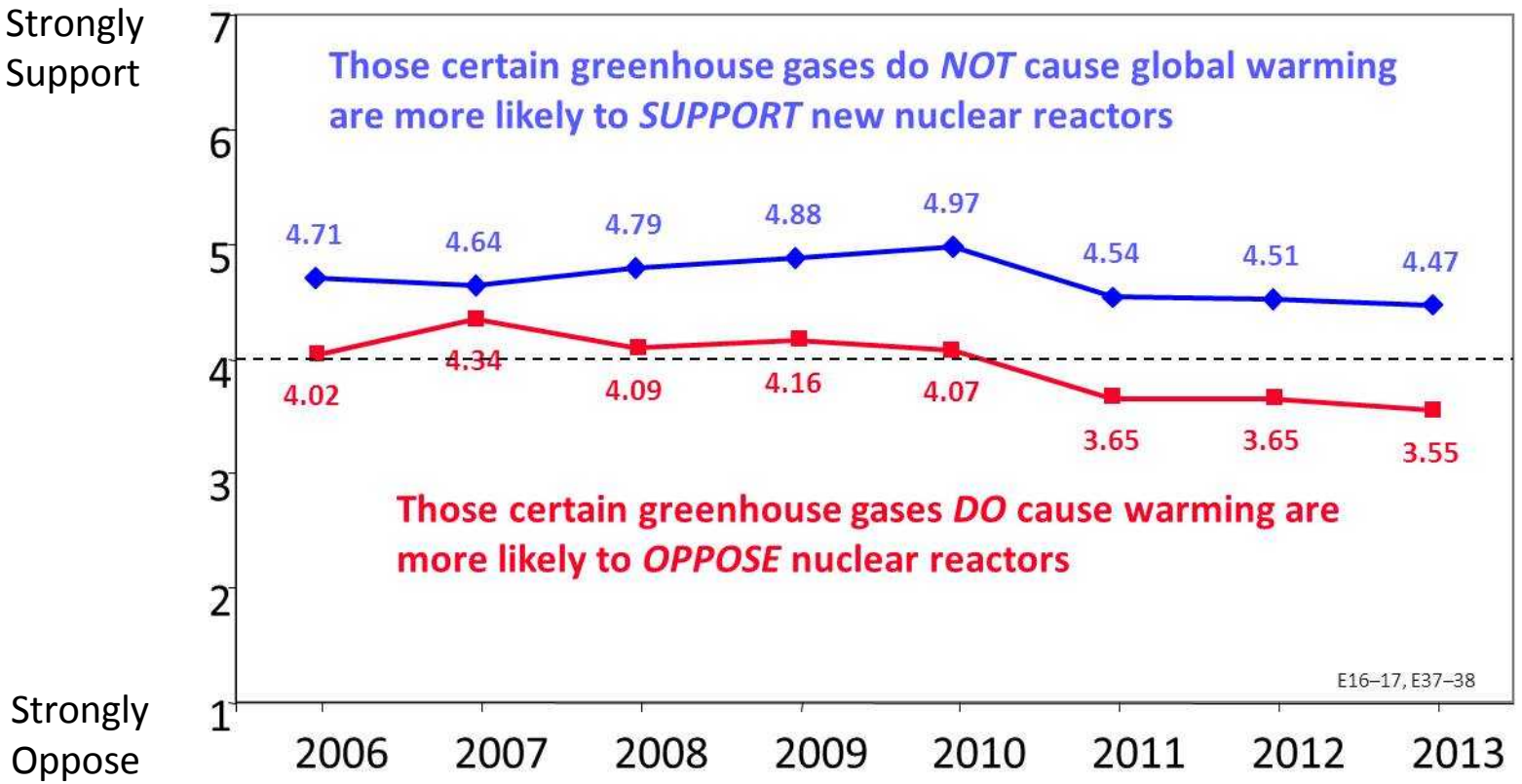
Fossil: + 20.7%

Nuclear: – 27.3%

# Beliefs on global climate change versus support for new nuclear reactors in US

Sandia National Laboratories

## Index of Mean Support for New Nuclear Reactors




**Change in support from 2006 to 2013**

**-5%**

**-11%**

# Take-away points

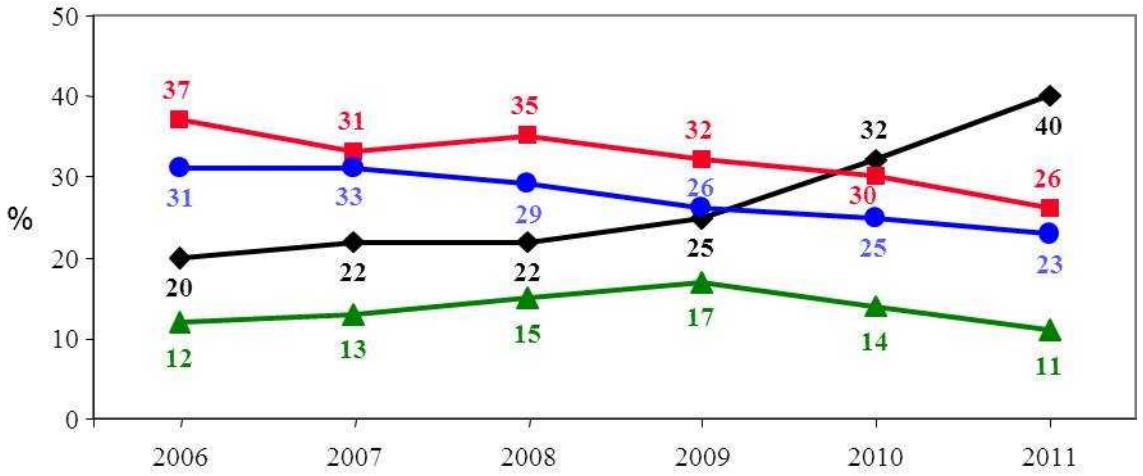
- Support for nuclear energy has eroded since 2010
  - But support remains for nuclear energy as part of overall energy mix
- Perceptions of nuclear energy risks have increased
  - Effects and implications of Fukushima still unfolding
- Greenhouse gases perceived to cause global climate change, but nuclear energy not seen as means to reduce them in US
  - Pervasive misunderstanding about nuclear generation producing greenhouse gases

# US public perspectives on nuclear issues between 2011 and 2013

- Nuclear energy in context
  - Trends in support for nuclear energy
  - Implications of beliefs on climate change
- US National Public awareness of SNF cycle
- Interim storage and geologic disposal
  - How options are presented matters
  - Implications of proximity
- Desirable characteristics of storage and disposal
- Institutional considerations and public engagement

# Awareness of current SNF management methods in 2011

What currently is being done with most US spent nuclear fuel?




Currently, spent nuclear fuel is being stored temporarily at > 100 sites in 39 states.

---

To the best of your knowledge, is spent nuclear fuel being stored above ground at any nuclear power plant within your state? (2011 responses)

| Correct | Don't Know | Wrong |
|---|---|---|
| **13%** | **59%** | **28%** |

# Take-away points

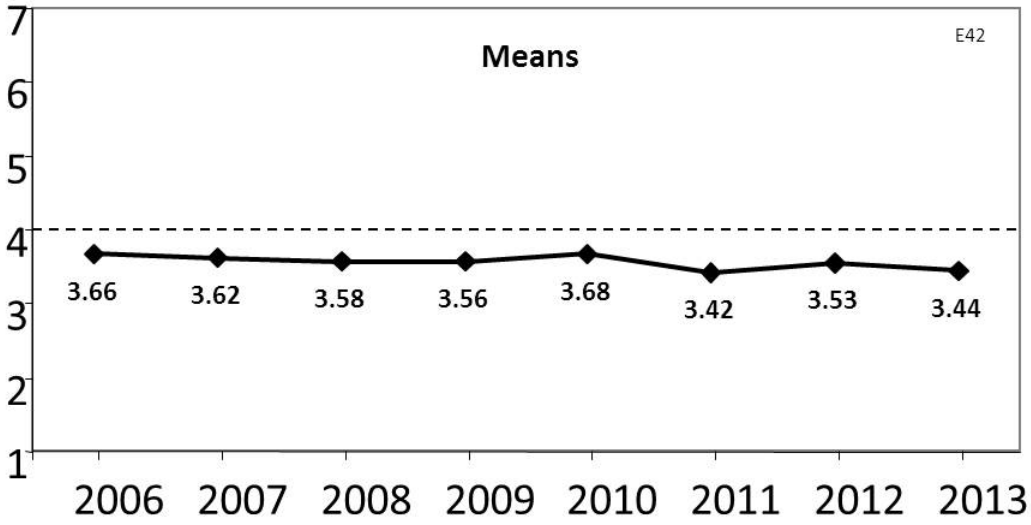
- Public knowledge of SNF management lacking
  - US public unaware of need for new policies; thus, public susceptible to misinformation
- Therefore, opinion measurement requires special techniques
  - Must establish/share minimum level of crucial factual information
  - Must present balanced policy arguments to establish context
  - Public engagement must consider both *risk* and *benefit*
  - University of Oklahoma and others have found providing crucial factual information results in consistent and reliable assessments over time

# What are the preferences of the US public related to repositories?

- Nuclear energy in context
  - Trends in support for nuclear energy
  - Implications of beliefs on climate change
- US National public awareness of SNF cycle
- Interim storage and geologic disposal
  - How options are presented matters
  - Implications of proximity
- Desirable characteristics of storage and disposal
- Institutional considerations and public engagement

# Trend in support for current storage practices

Strongly Support




Strongly Oppose

**2006–2013**

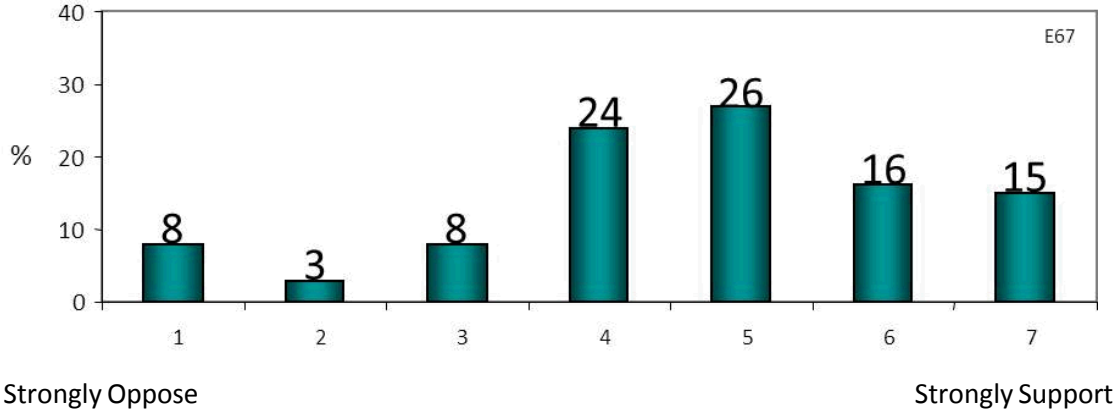
**Support: –6.0 %**

## 2013 Mean Support for Current Storage Practices

| AGE | EDUCATION | GENDER | RACE/ ETHNICITY | INCOME | POLITICAL IDEOLOGY |
|---|---|---|---|---|---|
| 18–29: 3.57 | < Col Grad: 3.37 | W: 3.34 | Minorities: 3.40 | < 50K: 3.37 | Liberal: 3.21 |
| 30–49: 3.43 | Col Grad: 3.53 | M: 3.54 | Majority: 3.46 | 50–100K: 3.46 | Mod: 3.46 |
| 50+: 3.38 | | | | > 100K: 3.62 | Consv: 3.65 |

# Support for geologic repositories in 2011

Two underground mine-like repositories several thousand feet deep; one in east and one in west; secure surface storage buildings; option for retrieval or permanent storage; each meets all technical and safety requirements of federal and state regulatory agencies




**Mean in 2011**

**4.65**

| AGE | EDUCATION | GENDER | RACE/ ETHNICITY | INCOME | POLITICAL IDEOLOGY |
|---|---|---|---|---|---|
| 18–29: 4.70 | < Col Grad: 4.56 | W: 4.38 | Minorities: 4.36 | < 50K: 4.58 | Liberal: 4.49 |
| 30–49: 4.58 | Col Grad: 4.76 | M: 4.93 | Majority: 4.71 | 50–100K: 4.73 | Mod: 4.58 |
| 50+: 4.67 | | | | > 100K: 4.91 | Consv: 4.96 |

# Support for interim storage facility in 2013

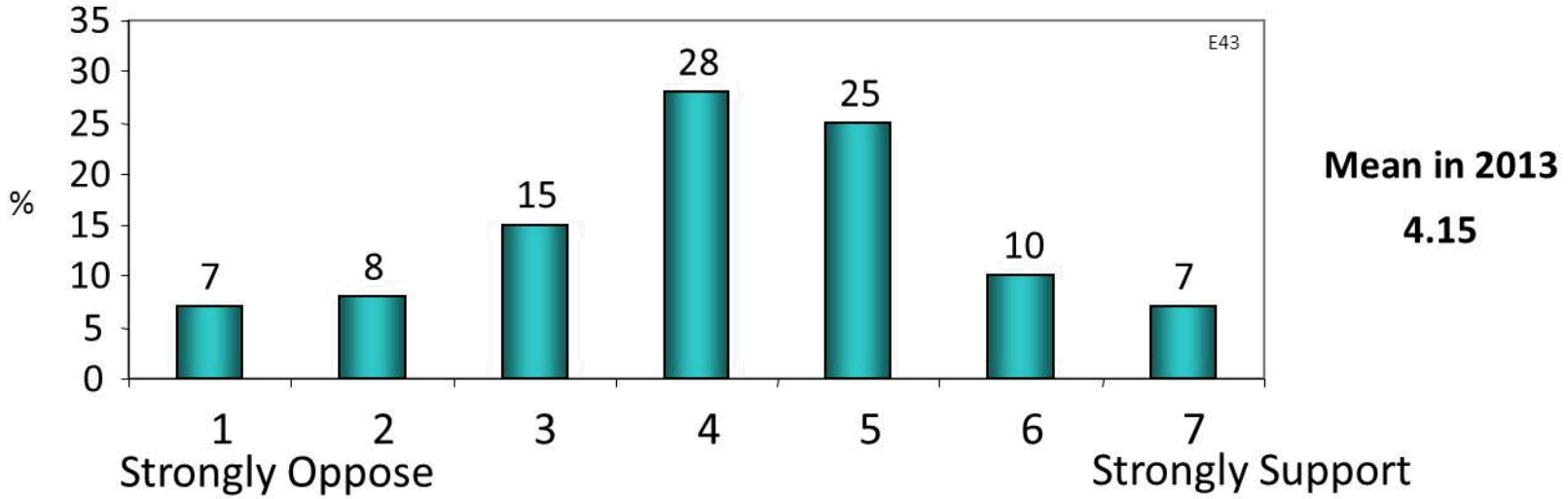
Sandia National Laboratories

**Arguments FOR:**

- Available much sooner
- Consolidates security
- Reduces on-site inventories
- Removes “stranded” fuel

**Arguments AGAINST:**

- Postpones long-term solution
- Adds transportation risks
- More costly
- No-harm from current practices



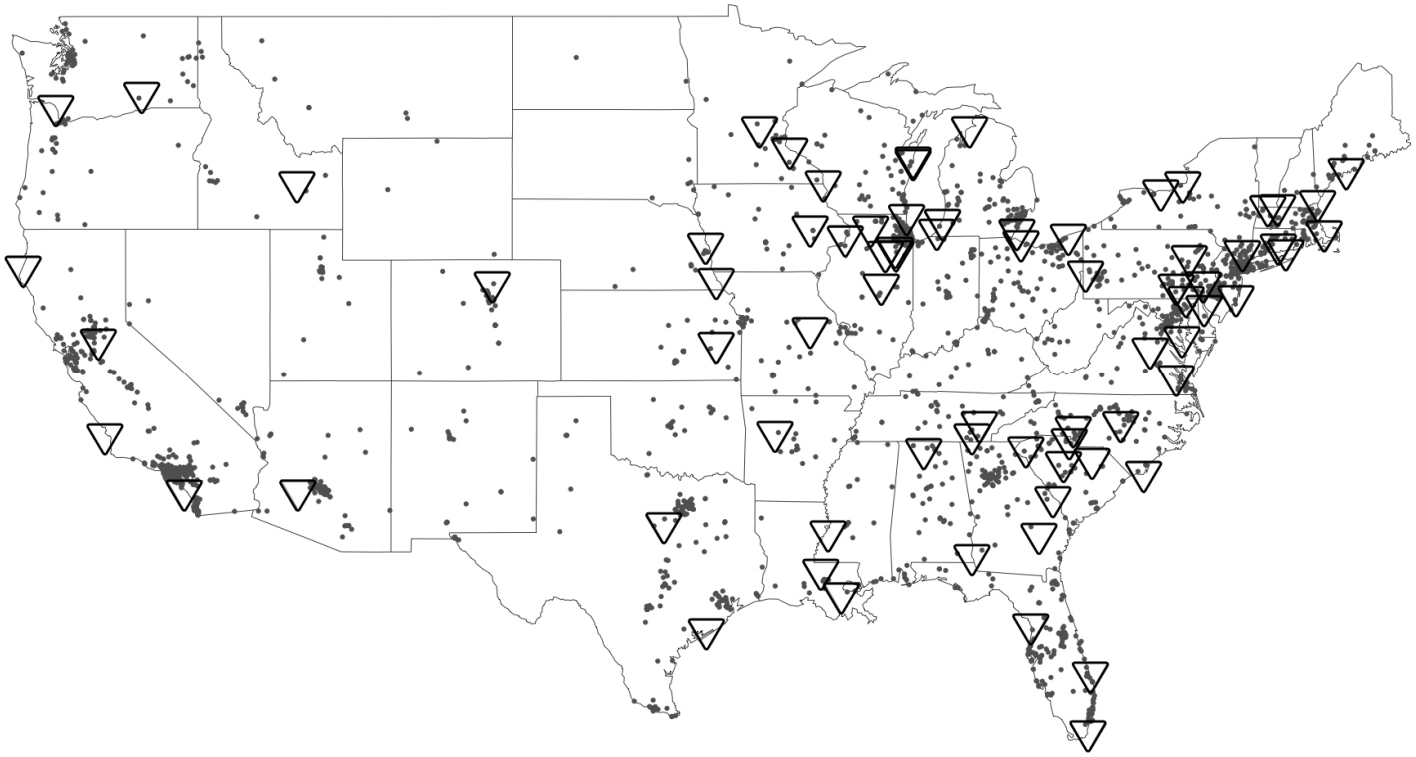
# Influence of proximity on responses to questions

- How does assumed proximity to *new* consolidated interim SNF facilities influence support or opposition?

- Does living near an *existing* SNF temporary storage site condition acceptance of future consolidated interim sites near one's residence?

# Proximity of respondents to temporary storage sites (primarily at reactors) in 2013

Sandia National Laboratories



**Estimates for Lower 48 Contiguous States:**

**76% of population (79% of 2013 respondents) reside within 100 miles of SNF**

**44% of population (46% of 2013 respondents) reside within 50 miles of SNF**

# If respondents learn how close they are to current storage, their response changed in 2012

Sandia National Laboratories

MEANS: 1 = Strongly Oppose—7 = Strongly Support

| Distance to ***Current*** SNF Storage | Repository 50 Miles Distant | Repository 100 Miles Distant | Repository 300 Miles Distant |
|---|---|---|---|
| Not shown (control) | 3.55 | 3.96 | 4.26 |
| Shown > 25 miles | 3.56 | 3.90 | 4.33 |
| Shown < 25 miles | 3.89 (+.34) | 4.79 (+.83) | 4.71 (+.45) |
| Model *F* stat. sig. | *Not Significant* | $p = 0.01$ | *Not Significant* |

| Distance to ***Current*** SNF Storage | Interim Storage 50 Miles Distant | Interim Storage 100 Miles Distant | Interim Storage 300 Miles Distant |
|---|---|---|---|
| Not shown (control) | 3.42 | 3.49 | 4.13 |
| Shown > 25 miles | 3.71 | 3.97 | 4.30 |
| Shown < 25 miles | 4.34 (+.92) | 4.12 (+.63) | 4.22 (+.09) |
| Model *F* stat. sig. | $p = 0.02$ | $p = 0.09$ | *Not Significant* |

# Take-away points

- When informed, respondents indicate unease with current on-site temporary storage
- Modest support for interim storage facilities
- Centralized storage and disposal are both preferred to continued on-site storage.

- Proximity to existing and proposed facilities has complex effects, simple not-in-my-backyard (NIMBY) effects misleading
  - Evidence that living near current SNF increases support for interim storage facilities
  - Proximity to new interim storage facilities may shift to support as impact on jobs and economy becomes known (as occurred at WIPP)

# US public perspectives on nuclear issues between 2011 and 2013

- Nuclear energy in context
  - Trends in support for nuclear energy
  - Implications of beliefs on climate change
- US National public awareness of SNF cycle
- Introducing the public to interim storage
  - How options are presented matters
  - Implications of proximity
- Desirable characteristics of storage and disposal
- Institutional considerations and public engagement

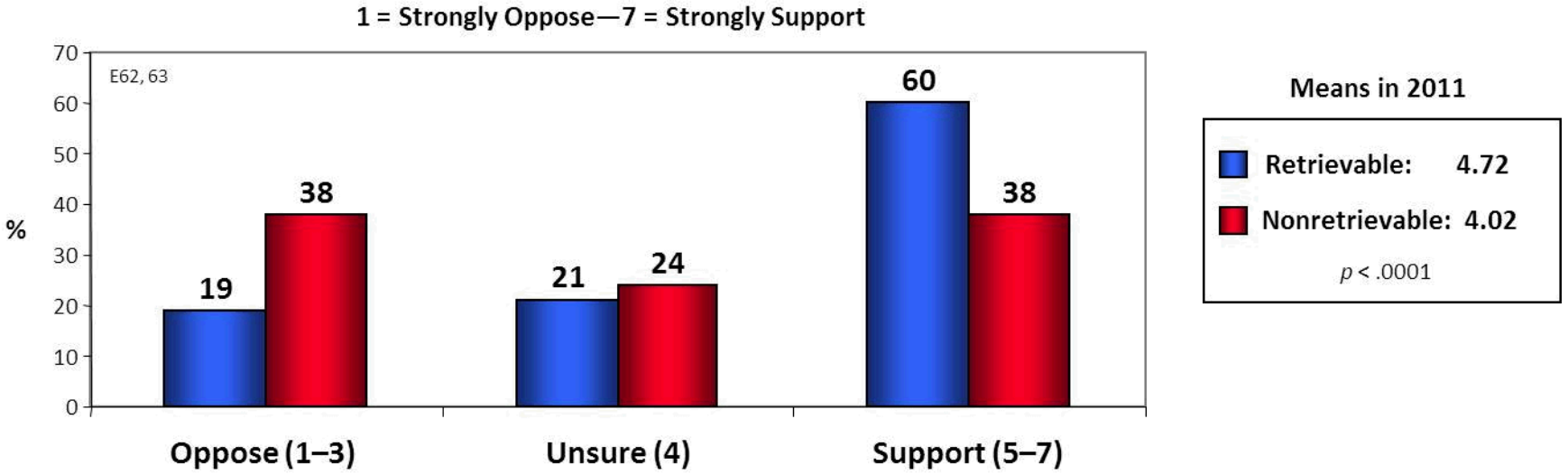
# Implications of repository design in 2012

| Design Factors | % Oppose | % Unsure | % Support | Means (1–7) | Change from Base Mean |
|---|---|---|---|---|---|
| **Mine-Like Repositories** | **17** | **26** | **57** | **4.65 (Base)** | N/A |
| With Research Lab | 9 | 18 | 73 | 5.21 | **+12.0%** |
| With Reprocessing | 14 | 24 | 62 | 4.84 | **+4.1%** |
| With Compensation | 16 | 23 | 61 | 4.81 | **+3.4%** |

# Value of waste retrievability in 2011

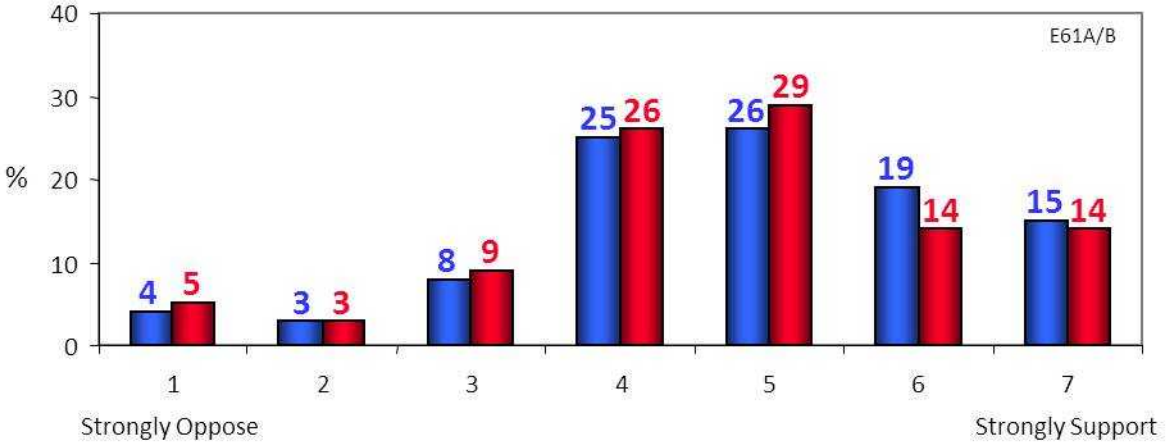
One option is to build facilities where the stored materials are continuously monitored and can be retrieved for reprocessing, or possibly to make them less dangerous using future technological developments. This option requires greater security efforts and may be more vulnerable to attack or theft.

Another option is to attempt to seal off storage sites in such a way that people cannot readily gain access to the materials in the future. This option is more secure, but does not allow reprocessing or treatment by future technological advancements.



# Value of SNF reprocessing in 2011

Reprocessing involves the chemical separation of radioactive materials in spent nuclear fuel. After reprocessing, most of the uranium and plutonium can be captured and reused to generate electricity, reducing the amount of uranium that must be mined in the US or purchased from other countries. Some remaining materials are highly radioactive and must be safe-guarded and isolated from the environment for thousands of years. In addition, substantial quantities of medium and low level radioactive materials are created by reprocessing, and these too must be disposed of in a way that safeguards people and the environment. Finally, reprocessing may also separate the plutonium which, like uranium, could be used to make nuclear weapons.




Means in 2011
With and without
further explanation
4.82 / 4.67

**Oppose: 15 / 17%** **Undecided: 25 / 26%** **Support: 60 / 57%**

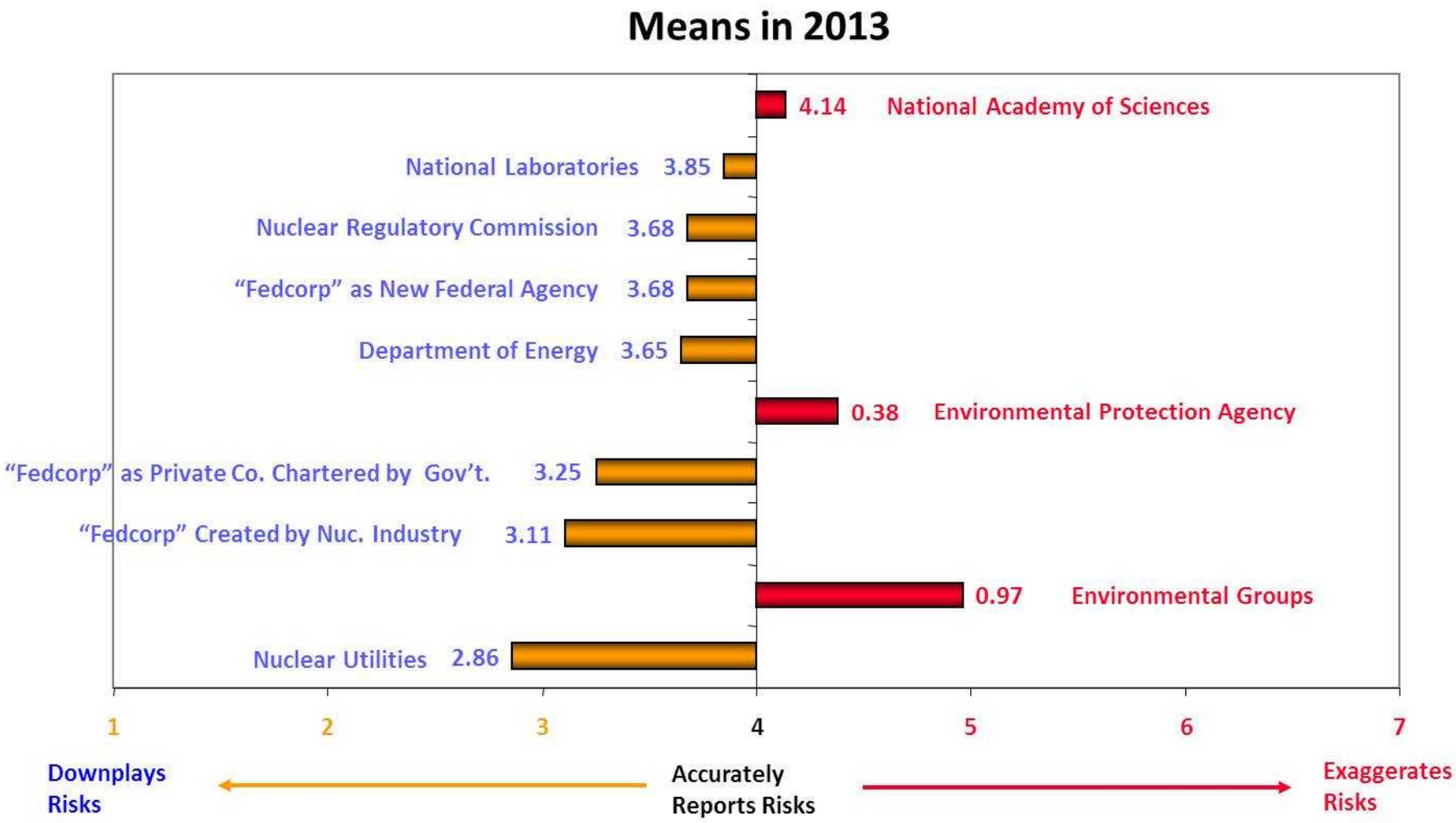
# Take-away points

- Facility design matters in US
- Implications of concept and design of repositories
  - Retrievability strongly favored
  - Mine-like facilities preferred over surface facilities or boreholes
  - Support for deep geologic repositories increases with…
    - Co-located research facilities
    - Reprocessing
    - Compensation positive but small

# US public perspectives on nuclear issues between 2011 and 2013

- Nuclear energy in context
  - Trends in support for nuclear energy
  - Implications of beliefs on climate change
- US National public awareness of SNF cycle
- Introducing the public to interim storage
  - How options are presented matters
  - Implications of proximity
- Institutional considerations and public engagement

# Perceived Institutional Risk Bias



# Find technically suitable sites first or communities volunteer first ?

- First make a ***technical decision*** that a particular site can be used to construct a safe and secure facility. This decision concerns such factors as the geologic, hydrologic, and population characteristics of the site (for example, avoiding earthquake-prone areas, flood zones, and densely populated areas). This decision is about technical requirements.

- First have ***a potential host community invite*** the siting of an interim storage facility. This decision concerns agreement by local residents and elected officials that technical experts can consider siting an interim storage facility nearby. This decision is about public support.

| % | ALL | Oppose storage | Support storage | Ecologically Unconcerned | Ecologically Concerned | Reside < 25 Miles from SNF |
|---|---|---|---|---|---|---|
| First determine technical suitability of candidate sites (E50) | **58** | 55 | 61 | 62 | 56 | 63 |
| First have state & local communities decide whether they would like to host ISF | **42** | 45 | 39 | 38 | 44 | 37 |

# Who should be allowed to block/veto a siting decision for an interim storage facility?

| | |
|---|---|
| A majority of citizens residing within 50 miles of the facilities (E64) | 68 |
| A majority of voters in the host state | 68 |
| Host state environmental protection agency or equivalent | 53 |
| U.S. Environmental Protection Agency | 50 |
| The governor of the host state | 49 |
| U.S. Nuclear Regulatory Commission | 44 |
| U.S. Department of Energy | 44 |
| Leaders of the host state's legislature | 34 |
| U.S. Congressperson representing the host district | 32 |
| Either of the two U.S. Senators representing the host state | 31 |
| Nongovernmental environmental groups in the host state | 21 |

# Likely participation in policy process

If storage / transportation route for SNF was proposed within 50 miles of your residence, how likely is it that you would …

| | Means | |
|---|---|---|
| **Likelihood of Activities** (1 = Not At All Likely—7 = Extremely Likely) | **Interim Storage** | **Transportation Route** |
| Attend informational meetings held by authorities (E75/T) | 4.37 | 4.22 |
| Write or phone your elected representatives (E78S/T) | 4.20 | 4.24 |
| Express your opinion using social media (E77S/T) | 3.96 | 4.02 |
| Serve on a citizens' advisory committee (E81S/T) | 3.92 | 3.91 |
| Help organize public ***support*** (E80S/T) | 3.07 | 3.09 |
| Help organize public ***opposition*** (E79S/T) | 3.05 | 3.10 |
| Speak at a public hearing in your area (E76S/T) | 2.97 | 3.08 |

# Take-away points

- Trust is greatest, and perceived risk bias least, for the NAS, the national labs, and federal agencies.
- Public participation
  - Most said they would attending informational meetings for consideration of consolidated storage and associated transportation routes
  - Equal concern for transportation routes and facility
  - About 22% indicated willingness to join support or opposition groups

Sandia National Laboratories

# Comments and Questions?